BRITISH·COLUMBIA'S

Planning for the Future

ENSURING CLEAN AIR

DEVELOPING A CLEAN AIR STRATEGY FOR BRITISH COLUMBIA

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ENSURING CLEAN AIR

Developing a Clean Air Strategy for British Columbia

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PREFACE

British Columbians enjoy a high quality of life which is supported by the beauty and diversity of the province's physical environment. The government of British Columbia is committed to sustaining the clean air, water and land which are vital to ecosystems and our quality of life.

Clean air is threatened by local, regional and global air quality issues which are linked, not only in their causes, but also in their solutions. We are committed to action to ensure clean air and to contribute to our global responsibilities. During 1992, a *Clean Air Strategy* will be developed to incorporate the views of British Columbians on ways to meet these goals.

The *Clean Air Strategy* will be developed through a consultative process with those interested and affected. The consultative process began with a Clean Air Conference in 1991, attended by more than 150 stakeholders. This discussion paper provides information to those interested in participating in developing a *Clean Air Strategy* for British Columbia, and is intended to fulfill four main objectives:

- **Provide information about the air quality issues important to British Columbians**, including local air quality, urban smog, ozone layer depletion and global climate change.

- **Summarize the views and concerns expressed by stakeholders** who attended the Clean Air Conference in 1991.

- **Outline the process that will be used to develop the *Clean Air Strategy*.** This process will include opportunities to contribute to the draft strategy, as well as to comment on the strategy before it is finalized.

- **Suggest some of the outcomes that are anticipated from the strategy**, including policies and priorities for action to ensure clean air.

The *Clean Air Strategy* will be part of the effort to update environmental legislation, policies and standards to reflect today's values and beliefs. The process of developing a strategy is not intended to delay actions which make sense now; actions will begin now, and continue during the planning phase.

If you would like further information on the strategy or this broader effort, a request form is provided at the back of this report. We look forward to an open dialogue on these important issues. Your participation is encouraged.

John Cashore
Minister of Environment, Lands and Parks

GLOSSARY

Atmospheric Lifetime	The average resident time in the atmosphere of a gas. The time is calculated as the number of years it would take for approximately 37% of the gas to be removed (also known as an exponential decrease) from the atmosphere.
BACT	Best available control technology is defined as currently available state-of-the-art control technology which is proven to be successful in reducing waste discharge and has been applied for at least one year in similar facilities in the Province or in other relevant jurisdictions.
BDMT	Bone dry metric tonne
CCME	Canadian Council of Ministers of the Environment
CFC	Chlorofluorocarbons. A serious man-made ozone layer depleter and a greenhouse gas.
CH_4	Methane. One of the greenhouse gases
CO_2	Carbon dioxide. Of greatest concern as a greenhouse gas
CO_2 Equivalent	The effects of various greenhouse gases over time are compared to CO_2. This effect is a function of the chemical properties of the gas and its lifetime in the atmosphere. It represents an estimate of the amount of CO_2 that a particular greenhouse gas is equivalent to. This term may also be referred to as the Global Warming Potential.
CRD	Capital Regional District
ECE	Economic Commission for Europe
Exceedance	The number of occasions per year that the Level B (maximum Acceptable) air quality objectives are exceeded.
GVRD	Greater Vancouver Regional District
Gigatonne	One thousand megatonnes (1,000,000,000 tonnes)
HCFC	Hydrochlorofluorocarbons. A potential replacement for CFCs as these gases are significantly less serious as ozone layer depleters than CFCs.
HF	Hydrogen fluoride. Emitted mainly from aluminum smelters
Megatonne	A million tonnes (1,000,000 tonnes)
IPCC	Intergovernmental Panel on Climate Change
NO_x	Nitrogen oxides emitted from combustion sources are key in smog production.

N_2O	Nitrous oxide. A greenhouse gas derived mainly from electrical transmission lines and agricultural activities.
O_3	Ozone. The main constituent of smog found in the lower atmosphere and, when found in the upper atmosphere (stratosphere), a filter for ultra violet radiation. In addition, ozone is a powerful greenhouse gas.
PAH	Polycyclic aromatic hydrocarbons are probable human carcinogens emitted during such processes as the incomplete combustion of biomass.
SO_2	Sulphur dioxide. A corrosive gas produced mainly from the combustion of fossil fuels that contain sulphur.
TOMA	Tropospheric ozone (or smog) management area
TRS	Total reduced sulphur. Composed of hydrogen sulphide, methylmercaptan, dimethyldisulphide and dimethylsulphide.
VOC	Volatile organic compounds. Emitted from sources such as oil based paints, automobiles and dry cleaning fluids. A catalyst in the generation of tropospheric ozone
$\mu g/m^3$	Micrograms (0.000,001 grams) per cubic metre
mg/m^3	Milligrams (0.001 grams) per cubic metre
mg/dm^2	Milligrams per square decimetre (0.001 grams/0.01 square metres)

1
INTRODUCTION

Today our directions in environmental protection are changing. The concepts of pollution prevention through Reduction, Reuse, Recycling, the Recovery of useful materials and energy and Residual waste management are well understood by most in our society. Market-based incentives (methods of intervening in the market to create environmental improvement) encouraging the 5Rs and other forms of pollution prevention are being considered as alternatives to more traditional regulatory approaches. In addition, public and consumer education processes to further this cause are looked upon as strategic priorities.

The Ministry's Legislative foundation is being reviewed to ensure that it provides adequate support for the new initiatives. Policies, standards and regulations will all be reviewed and updated to meet our emerging environmental mandate. Throughout this period of rapid change, consultation will be critical to ensure that the desires of British Columbians are reflected in the Ministry's efforts.

New Atmospheric Issues and Pollution Sources

British Columbians increasingly face air quality problems that have not been regulated with the traditional focus on industrial sources. The issues of the '90s are urban smog, acid rain, ozone layer depletion and the potential for global climate change. The pollutants responsible differ from those historically regulated, and often come from numerous diffuse sources, rather than a few point sources.

The Need For New Approaches

Air quality management will increasingly need to rely on new approaches. Chief among them will be securing the cooperation and understanding of the general public. In addition, because of the inter-relationships between the issues, a wide variety of sectors and agencies will need to be onside. Examples include transportation and energy management in the short term, and infrastructure planning and urban design in the longer term. Concepts of product stewardship, cradle-to-grave management, zero pollution, and living within the assimilative capacity of nature are now being referred to as necessary human behaviour. These require that we

make a complete change in our approach to decision making and in the way that we live.

Increasingly, there is a focus on market-based measures (e.g., taxes) to include environmental values in our economy-based society. Measures such as incentives, charges, user-pay fees, deposits and refunds, purchasing policies, taxes, and emission trading are seen as options for managing emissions. The public expects government leadership in exploring these possibilities.

Efforts That Require Coordination

Initiatives to deal with environmental issues are currently underway from all levels of government, from the public, and from the private sector. In some cases these initiatives are not coordinated, fail to recognize the inter-relationships between the issues and may result in conflicting controls on the same pollution sources. To resolve these conflicts there needs to be a common understanding of the issues and the relationships between them. Also, a strategy is needed to coordinate the initiatives in order to maximize their overall effectiveness, and to minimize their burden on the taxpayer, the consumer, and industry.

Table 1. **Summary of International Targets***

Pollutant gas	Agreement	Commitment	Base year	Target year
Greenhouse gases	International meetings	Stabilization of gases	1990	2000
CFC/Halon	Montreal Protocol	Elimination of unnecessary uses	—	1997
NO_x	ECE Protocol	Stabilization	1987	1994
	U.S./Canada accord	Scheduled reductions from industry. Tighter standards for motor vehicles		
VOC	ECE Protocol	Stabilization of national total. 30% reduction in TOMAs	1988	1999
SO_2	U.S./Canada accord	National cap of 3.2 million tonnes	—	2000

* Many of the protocols also contain other requirements.

Several of the pollutants of concern to British Columbia are addressed by national and international agreements. Typically, these agreements contain targets, as outlined in Table 1. As well, the agreements contain other requirements such as monitoring and information exchange. Further reference to these agreements is made in Section 2. British Columbia's efforts to respond to these agreements are focused mainly through the Canadian Council of Ministers of the Environment (CCME), a federal/provincial body established to find cooperative solutions to complex environmental problems. The following are five examples of current cooperative activities undertaken by the Council:

- CFC/Halon Elimination Strategy (ozone layer protection)
- National Action Strategy on Global Warming (greenhouse gases)
- NO_x/VOC Management Plan (ground-level ozone)
- Cap on sulphur emissions (acid rain)
- Canada/U.S. air quality accord (acid rain, visibility)

British Columbia is involved in all of these initiatives and in a variety of ways:

- Developing CFC regulations, and a strategy for their implementation.
- Developing inventories of greenhouse gases, and options for their management.
- The AirCare program will require motor vehicle inspection and maintenance and will reduce emissions which cause ozone smog.
- Updating standards and inventories for air contaminant emissions employing BACT.
- Providing a clear framework for the environmental evaluation of proposed emission sources.
- Developing management options to reduce smoke emissions from a variety of sources.

Each of these requires extensive stakeholder consultation and broad, coordinated implementation. In addition to dealing with these national and global initiatives at

the provincial scale, local and regional governments have become concerned about the quality of air their constituents see and breathe, as well as the effect it has on their health and on industries such as tourism. As a result, and as indicated in the points listed below, they are increasing their involvement in air quality issues:

- GVRD air management plan to improve and maintain future air quality.
- City of Vancouver "Clouds of Change" task force.
- CRD Atmospheric Task Group is focusing on both local and global issues.
- Okanagan regional districts discussing an air management plan.
- Four Lower Fraser Valley regional districts proposing a multi-district air management board.

Governments are not alone in these efforts; industry is also involved. Examples include the *Go Green* campaign in the Lower Mainland (jointly sponsored by BC Transit, GVRD, Environment Canada and B.C. Ministries of Environment, Lands and Parks, Attorney General and Energy, Mines and Petroleum Resources), and BC Hydro's *PowerSmart* and *ResourceSmart* programs.

With so many groups involved in trying to create change, an overall framework is needed to ensure that a change for the best is brought about. The *Clean Air Strategy* is to be that framework.

To begin the development of the strategy, this discussion paper outlines some of the most significant local, regional and global atmospheric issues that affect the environment and people of British Columbia. These issues, outlined in Section 2, range from local air quality in the vicinity of industrial operations, through regional concerns such as smoke haze in the Interior and ground-level ozone smog in the Lower Fraser Valley, to issues of global concern, including the thinning of the ozone layer and global climate change.

Consultative Process

The *Clean Air Strategy* can best be developed through a consultative process with those interested and those affected. The first phase, a consultative process, began at the conference *Developing a B.C. Clean Air Strategy* held in 1991 in Vancouver.

Section 3 summarizes the views expressed by stakeholders at that conference; a more complete record of the conference is available on request. The next phase leading to the finished strategy and planned to take place over the next year, is outlined in Section 4.

But this is only the beginning. The dialogue started in 1991 must continue. It must now be focused on producing that *Clean Air Strategy* within the year.

Anticipated Outcomes

It is hoped that the *Clean Air Strategy* process will lead to several ends[1]:

- An overall vision for atmospheric environmental quality in British Columbia.
- Definitions of the issues, descriptions of their inter-relationships, and preferred options for their solutions.
- Clear priorities for future pollutant prevention and management activities.
- A description of the consultative process that is needed in future.
- Agreement on cooperative approaches, decision-making frameworks and dispute resolution mechanisms.
- Institutional frameworks for regional air management.
- A mix of short-term actions and longer-term approaches, including:
  - — Endorsement of a new Environmental Protection Act.
  - — Enactment of policies and standards.
  - — Implementation of market-based measures.
  - — Research, monitoring, inventory and assessment.
  - — Development of strategic and operational plans.
  - — Regional planning initiatives.
  - — Public education and involvement.

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[1] These are described in more detail in Section 5.

2
ATMOSPHERIC ISSUES

The atmosphere of our planet is unique. It is made up of approximately 78% nitrogen, 21% oxygen, 0.03% carbon dioxide, 0.000,001% ozone and other trace gases. As well, the atmosphere contains an exceptionally variable amount of water vapour, ranging from near zero to as much as four percent. Through the activities of man, the chemical composition of the atmosphere has changed and, as a result of these and continuing changes, atmospheric quality is jeopardized locally, regionally and globally. In fact, it has already deteriorated in many regions of the world.

We British Columbians value the high quality of air that exists in much of our province, and we want to keep it clean. The unique geography of British Columbia, with its high mountains and deep valleys, is often conducive to the trapping of air pollutants. Air pollution problems that occur under these specialized conditions will require innovative solutions. In addition, the government of British Columbia, through interprovincial and international commitments, is dedicated to finding solutions that will reduce emissions of pollutants that cross international boundaries or contribute to global problems such as ozone layer depletion and global climate change.

Air Quality

While traditional atmospheric concerns tend to focus on local effects, particularly odour and visibility, these are symptoms of a much bigger problem brought on by many activities undertaken by society. In the following sections several of the more important concerns will be reviewed. For each case the symptom or concern, the type of emission, its effect, primary sources, levels, and actions that could be taken to address it will be presented. While each will be treated separately, it is important to recognize how they often relate to one another and how, by thinking of the issues holistically, solutions can be chosen that will address several issues at a time. Care must be taken, however, to avoid making one issue worse while solving others, or shifting the problem from air to water or to a landfill, and thereby posing other problems.

The discussion that follows begins with a review of air quality standards and proceeds to descriptions of those local issues familiar to everyone. It then progresses through to global issues, the effects of which will not be felt for many years, often by future generations.

Air Quality Standards

Historically, British Columbia's air quality concerns have been centred on industrial point sources (e.g., pulp mills, refineries, mines, smelters and saw mills). Pollution Control Objectives (PCO) have been established for several industry sectors including forest products, chemical and petroleum, mining and smelting, food processing, agriculture, and municipal type waste discharges. The standards for the ambient air in British Columbia (Table 2) were derived from the scientific literature and were first established in the early 1970s.

The objectives have been grouped into three categories: Levels A, B and C.

- Level A (maximum desirable) objectives are intended to provide long term protection.

- Level B (maximum acceptable) objectives are intended to provide adequate protection against adverse effects on human health, vegetation and animals.

Table 2. **Ambient Air Quality Objectives for British Columbia**

Parameter	Averaging period	Units[3]	Level A	Level B	Level C
Nitrogen dioxide[1]	1-hour	µg/m³	–	400	1000
	24-hour		–	200	300
	1-year		60	100	–
Carbon monoxide[2]	1-hour	mg/m³	14.3	28.0	35.0
	8-hour		5.5	11.0	14.3
Hydrogen (TRS) sulphide[2]	1-hour	µg/m³	7	28	–
	24-hour		3	6	–
Sulphur dioxide[2]	1-hour	µg/m³	450	900	–
	24-hour		160	260	800[1]
	1-year		25	75	–
Ozone[1]	1-hour	µg/mg³	100	160	300
	1-year		–	30	–
Total suspended particulates[2]	24-hour	µg/m³	150	200	400[1]
	1-year		60	70	–
Total dustfall[2]	30-day	mg/dm²/day	1.75	2.90	–

Notes: (1) Government of Canada Air Quality Objectives
(2) British Columbia Air Quality Guidelines & Objectives
(3) See Glossary for an explanation of units.

- Level C (maximum tolerable) objectives denote concentrations of air contaminants beyond which, due to a diminishing margin of safety, require appropriate action without delay to protect the health of the general population.

Standards have not been developed for all air contaminants of concern in our province, such as air toxics. Future standards or guidelines will be a balance between our knowledge of effects on the environment and the preferences of society for a degree of protection. As a result, these standards will be reviewed continually in response to our understanding of the pollutants, the issues defined by society and the potential impacts on the affected areas.

Local Issues

The latest assessment of provincial air quality is published in the document , *Air Quality in British Columbia 1983–1987.*

Total Reduced Sulphur There are some localized air pollution issues that are primarily related to the specific industry located in the area. Of particular importance is a group of odorous compounds called Total Reduced Sulphur (TRS). In British Columbia, the major sources of TRS are pulp mills and natural gas processing plants and among the more common TRS compounds is hydrogen sulphide. As shown below (Figure 1), the existing provincial air quality objectives have frequently been

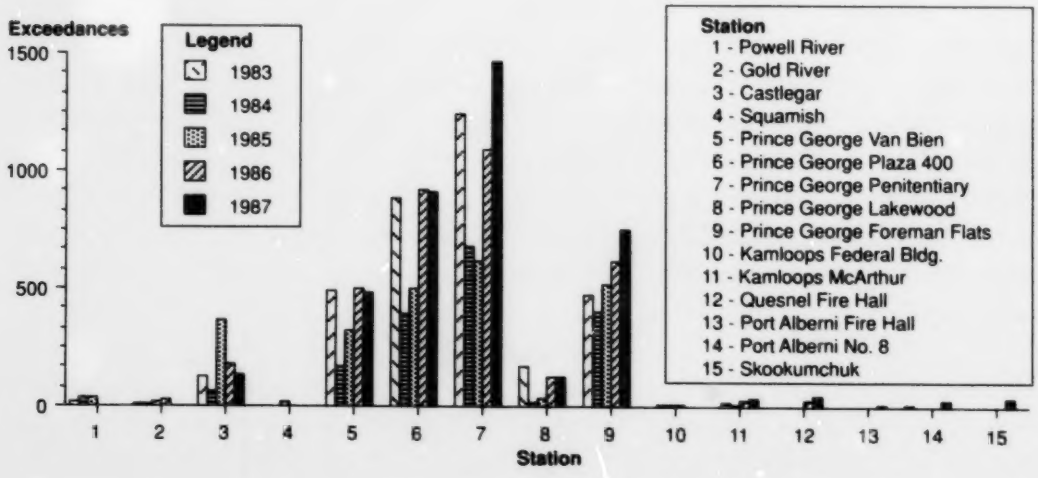

Figure 1. Annual number of one-hour TRS greater than Level B.

exceeded at several locations throughout the province. The most serious emissions of TRS have been confined to Prince George and Castlegar. The pollutant levels in Prince George have improved significantly in the recent past and an expanded mill is under construction at Castlegar that will employ Best Available Control Technology (BACT) to reduce emissions.

Hydrogen sulphide (H_2S) can cause effects in humans ranging from a detectable rotten egg smell to lung and eye irritation. Under extreme conditions, H_2S can lead to unconsciousness and eventually, if the person is not removed from the source of the exposure, death.

Smoke and Visibility Smoke and, as a consequence, reductions in visibility are a serious local issue in our province. The nature of the smoke problem is such that the source of the offending emission can be local (e.g., backyard burning or wood stove smoke) or regional (e.g., prescribed burning). In fact, slash burning in Washington State has often impacted on local and regional air quality in British Columbia and vice versa. As a result of the considerable concern throughout the province on this issue, this topic will be explored more fully under Regional Issues and in the companion document, *Smoke Management for the '90s.*

Sulphur Dioxide (SO_2) Sulphur dioxide is a corrosive gas produced mainly from burning of sulphur-containing fuel and from various industrial processes such as non-ferrous smelting, refining, natural gas processing, and power production. Acid rain is produced when sulphur dioxide is converted to acidic compounds such as sulphuric acid and sulphates, and returns to earth. Sulphur dioxide in the environment can have a detrimental effect on plants, human health, and building materials. Generally, vegetation is one of the most sensitive receptors. Sulphur dioxide levels have not exceeded the ambient air objectives as often as TRS, but, there have been an appreciable number. For example, high levels occur around the sulphite mill in Port Alice and to a lesser extent at several sites near mining and smelting facilities in the Interior near Trail. Technical modifications at these facilities incorporating high efficiency scrubbers and process changes are being implemented to reduce SO_2 emissions.

Hydrogen Fluoride (HF) Hydrogen fluoride is a slightly acidic gas emitted largely from aluminum smelters and to a lesser extent from fertilizer plants and incinerators. Being acidic, it also contributes to the formation of acid rain. Atmospheric hydrogen fluoride affects the growth and development of vegetation and can have adverse

effects on livestock consuming contaminated forage. In British Columbia, high levels of hydrogen fluoride in ambient air occur in the vicinity of the aluminum smelter in the Kitimat Valley. In the recent past, technological changes have been made to reduce the fluoride emissions and there appears to have been an improvement in the ambient fluoride levels.

Airborne Toxic Chemicals, also called hazardous air pollutants, are of concern because they can have either an immediate or a long-term harmful effect on human health. They include a wide variety of chemicals that may be present in trace amounts in the atmosphere. Examples of air toxics in British Columbia include polycyclic aromatic hydrocarbons (PAH), formaldehyde, trichloroethylene, benzene, dioxins, and trace metals such as arsenic, cadmium, chromium, beryllium, lead and mercury compounds.

Air toxics are an emerging area of concern that has received considerable attention in the United States in recent years. In the United States, the Clean Air Act has recently identified about 150 chemicals as hazardous air pollutants that must be assessed in existing emissions and in proposed projects. Although efforts in Canada are less developed, the CCME has identified 53 chemicals for particular attention as air toxics. Environment Canada has also developed a Priority Substance List containing about 44 potentially hazardous substances, which include some of the well-known air toxics. Many of the chemicals are common to the three lists. These lists will provide initial guidance for developing a program for identifying and managing air toxics in British Columbia.

A limited amount of monitoring for air toxics has been carried out in the province. Sophisticated instrumentation and analysis are required, with associated costs of hundreds or thousands of dollars per sample. Many air toxics are managed currently through permits on industrial facilities. In addition some volatile organic compounds (VOC) are considered air toxics and their control will be part of the CCME Management Plan for nitrogen oxides and volatile organic compounds. A more comprehensive program will be developed in future including standards for individual chemicals, inventories of their sources, monitoring of their atmospheric concentrations and strategies for their control.

Regional Issues

Smoke and Visibility Smoke is an air quality issue facing the majority of British Columbians. The sources of smoke are varied and include the burning of forestry slash, sawmill residues, land clearing debris, agricultural residues, backyard residues (wastes), and firewood for woodstoves and fireplaces. The smoke plumes from all these activities contain particulates that may impede visibility or cause breathing difficulties for some residents.

The most pressing concerns are health-related, but the visibility problems associated with excessive smoke have implications for transportation safety and for tourism and personal enjoyment. The recent U.S./Canada Air Quality Accord contains *requirements* that programs be developed in Canada by 1995 *to protect visibility* in pristine areas, comparable to programs currently in place in the United States.

Smoke from prescribed burning (slash burning, range habitat improvement and fire protection) and teepee burners are among the most common air quality complaints reported by the public. Certain types of burning by the forest industry are necessary; but, in many areas, alternatives must be examined. For example, the forest industry annually disposes of thousands of tonnes of wood residues through burning or landfill. The provincial distribution of wood residue is given in Figure 2 in bone dry metric tonnes (BDMt). There is an obvious surplus of biomass that is not evenly distributed throughout the province. The issue of wood residue burning and landfill is currently under review and among the most promising means of making use of this valuable resource is co-generation. This involves the burning of the biomass to generate electricity, an approach currently planned for use in Williams Lake.

Recent measurements made by BC Environment suggest that, under certain meteorological conditions, some known human carcinogens occur in combination with fine particulates in the emissions resulting from backyard burning and woodstove use. In attempting to minimize these emissions, some municipalities have banned backyard burning, while others, including Cranbrook and Comox, are now restricting the period of operation of woodstoves based on meteorological conditions.

As noted above, smoke from the burning of biomass is a major concern to British Columbians. As a part of the general discussion on a Clean Air Strategy, we will also hold more detailed discussions on smoke management options.

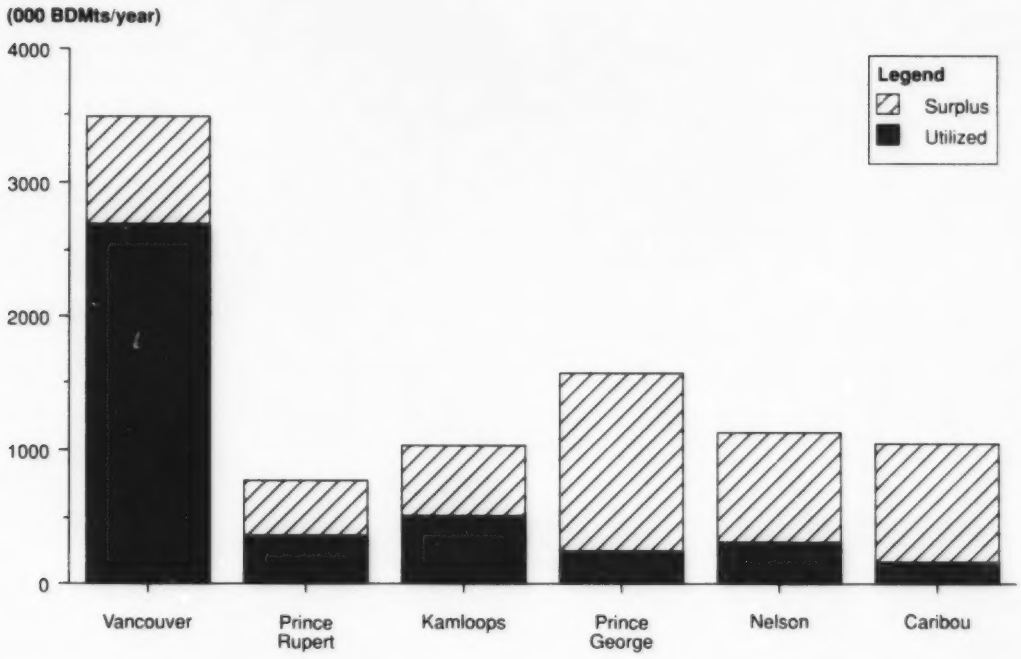

Figure 2. Regional wood residue utilization in British Columbia by Forest Region (Source: B.C. Ministry of Forests).

Ground Level Ozone Smog Ground level ozone is a major component of urban smog. Some areas of our province are subjected to periods of reduced air quality due to ozone smog. Ozone episodes occur in the summer months when weather is sunny and warm and sufficient nitrous oxides (NO_x) and VOC are present. Ozone is formed near the ground by photochemical reactions between these two precursor pollutants in the presence of sunlight and warm temperatures.

Monitoring is most extensive in the Lower Fraser Valley where O_3 concentrations exceed the federal maximum acceptable level several days per year and have exceeded the maximum tolerable level several times in the past decade (Figure 3). Limited data from the Okanagan and Greater Victoria areas suggest that ozone is not currently a significant issue, but present growth rates in those areas support the need for additional monitoring and regional transportation planning to prevent future deterioration.

In British Columbia, emissions of these two compounds are mainly from transportation sources. A description of the sources of NO_x and VOC in the Lower Fraser Valley is shown in Figures 4 and 5. NO_x is mainly (77%) derived from

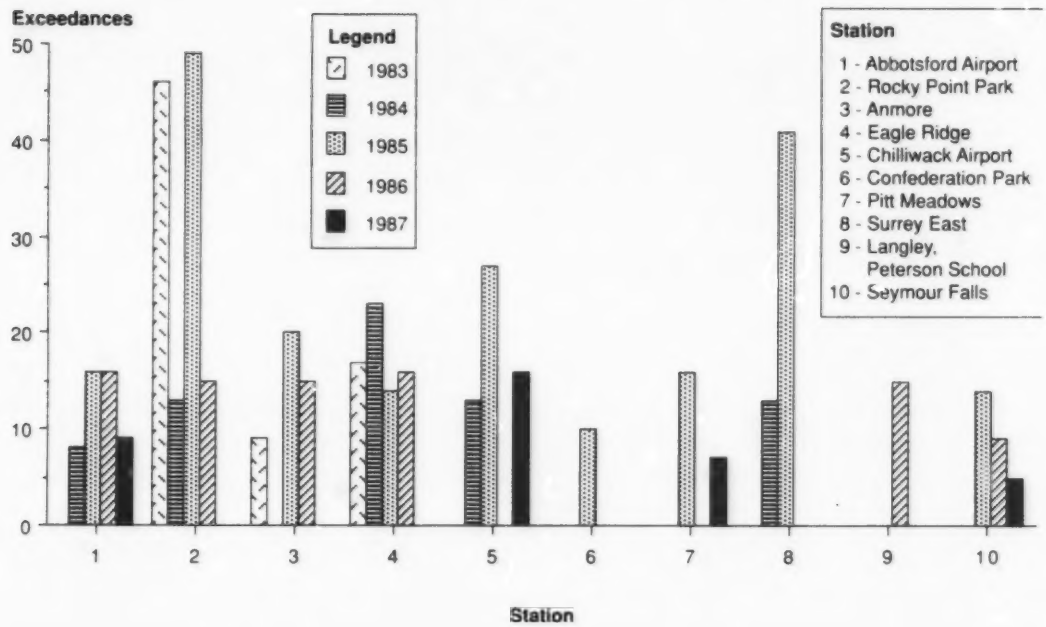

Figure 3. One-hour ozone occurrences greater than Level B at ten locations in the Lower Fraser Valley for a five-year period — 1983–1987.

transportation and the combustion of fossil fuel. Approximately 53% of VOCs are derived from transportation while 20% are emitted by natural sources such as forest. The high density of automobiles and abundant summer sunshine, combined with unique geography, make the Lower Fraser Valley susceptible to the formation of smog. In addition, some of the NO_x/VOC contributing to degraded air quality in the Lower Fraser Valley originate in Washington State.

The Canadian Council of Ministers of the Environment (CCME) have endorsed a NO_x and VOC management plan that will meet Canada's international obligations and address domestic ozone smog problems. Three areas in Canada, including the Lower Fraser Valley, have been targeted for emission reductions to solve existing problems. The details of the plan are under discussion with Environment Canada and the Greater Vancouver Regional District. They will be specified in intergovernmental agreements.

Tropospheric (ground-level) ozone smog may cause adverse effects on human health. Prolonged exposure to ozone can progressively decrease lung function. Also, many health professionals are concerned that repeated exposure to ozone over

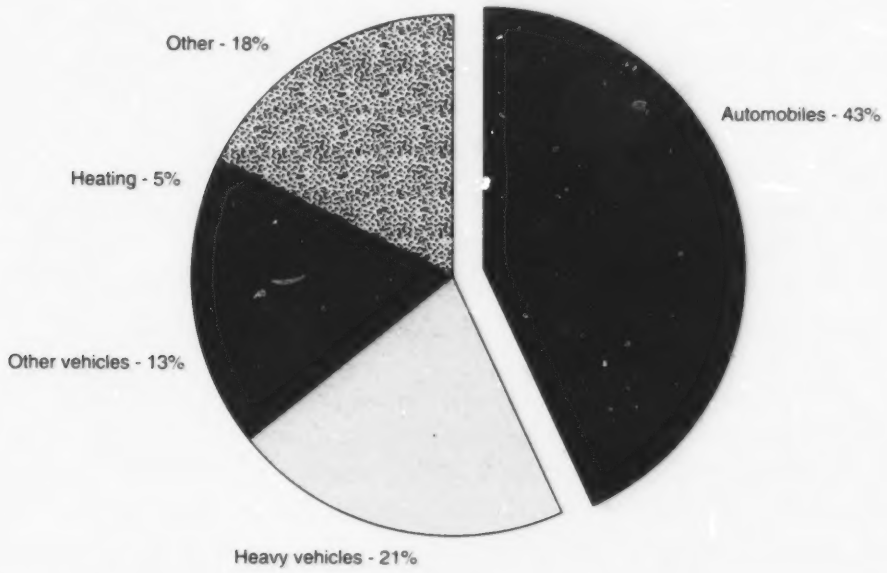

Figure 4. NO_x emissions in the Lower Mainland by source in 1985.

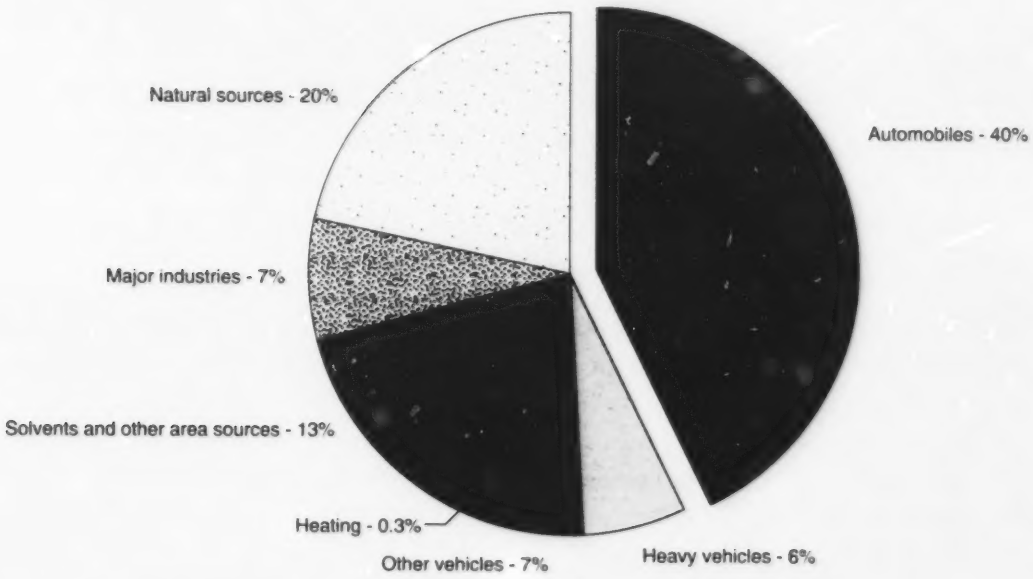
Natural sources - 20%
Automobiles - 40%
Major industries - 7%
Solvents and other area sources - 13%
Heating - 0.3%
Other vehicles - 7%
Heavy vehicles - 6%

Figure 5. VOC emissions in the Lower Mainland by source in 1985.

a lifetime may result in permanent impairment of the lungs. Finally, the effects of ozone on vegetation have been well documented.

The need to reduce the emissions of NO_x and VOC is evident in the Lower Fraser Valley due to the present levels of ozone smog. However, VOCs such as those found in gasoline, dry cleaning fluids and solvent-based paints can also be toxic in their own right. Management measures are currently focused mainly on the Lower Fraser Valley, but other areas, including the Okanagan Valley, are considering the management implications of these emissions on their air quality program.

Acid Rain The term acid rain is today a household word in most industrialized countries, yet 15 years ago it was familiar only to a few environmental scientists. Some compounds emitted into the atmosphere through the activities of society are acids or become acidic when they reach the Earth's surface and interact with water, soil, or plant life. This phenomenon is commonly referred to as acid rain, though the deposition may take place in wet or dry form; in rain, snow or fog.

The major emissions affecting the composition of acid rain are oxides of sulphur and nitrogen. Gaseous and particulate sulphur and nitrogen emitted into the atmosphere may be dry deposited near the source within a day. When the gaseous components are oxidized to acids, the time they spend in the air becomes longer, ranging up to several days. This means that a substantial portion of the acidifying air pollutants is transported by the winds hundreds or even thousands of kilometres from the source of emission. Because the wind direction changes, air pollutants emanating from one place will be carried away to many different points of the compass, increasing the possibility of acidifying locations far removed from the pollution source.

British Columbia, because of its geography, is located "up-wind" of most sources of acidic deposition generated outside our province. The exceptions are large sources of sulphur dioxide located in the state of Washington. Under certain meteorological conditions, these sources may impact on locations in south-west British Columbia and, in addition, emissions generated in our province may be transported to Washington state.

The acid rain problem in our province (Figure 6), though potentially of concern, is much less pronounced than that found in other areas of North America. In British Columbia there are only a few areas with soils sensitive to precipitation acidity. These soils lack the capability to neutralize this additional acidity. Some of these

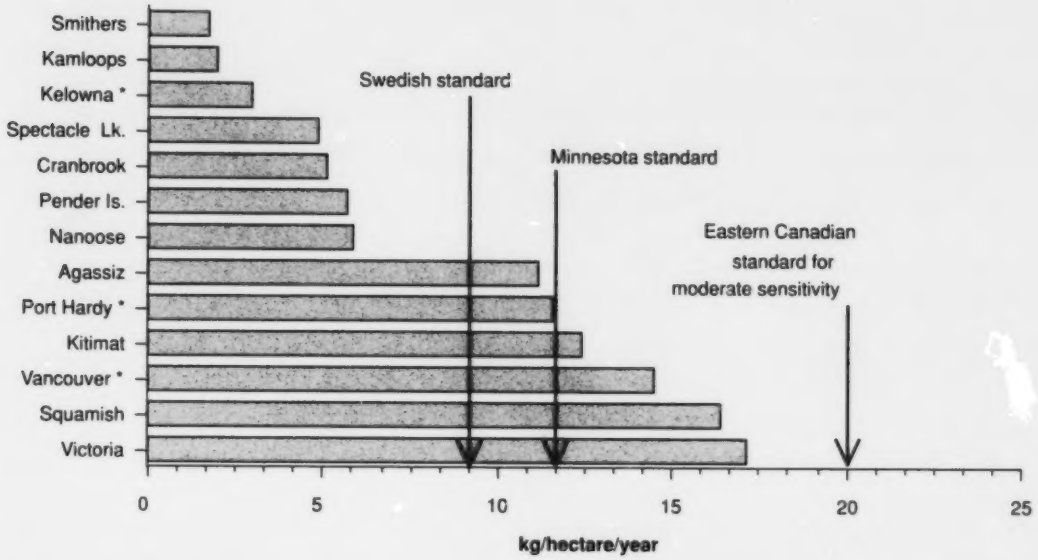

Figure 6. Acidic deposition at thirteen locations in British Columbia based on 1985 data.

sensitive areas are located along the mainland coast, the Queen Charlotte Islands, and the west coast of Vancouver Island. In these areas, there are precursors to acid precipitation such as SO_2, which are emitted into the atmosphere from industrial sources and NO_x emitted mainly from automobiles in urban centres. These emissions would contribute to acidic precipitation.

On Vancouver Island, most of the emissions of sulphur dioxide currently originate from six pulp mills. A reduction in sulphur emissions will result from the introduction of the Vancouver Island natural gas pipeline and the consequent transition from bunker oil. However, since the majority of the SO_2 from pulp mills is emitted from the recovery boilers, which are fuelled mostly by pulping liquors, the reductions in sulphur emissions will likely be slight. In the Lower Fraser Valley, nine facilities emit the majority of the SO_2. In the northern coastal region, three large plants release SO_2, with the largest share emitted from the aluminum smelter at Kitimat.

Global Issues

The emission of some compounds to our atmosphere has effects reaching far beyond the boundaries of our province. These gases are transported into the atmosphere and distributed globally. The major global atmospheric issues of concern to British Columbians are stratospheric ozone depletion and global climate change.

Stratospheric Ozone Depletion Ground level ozone smog is generated in some urban centres and is detrimental to human health and vegetation. Naturally occurring ozone, found in the stratosphere at an elevation of approximately 20 km, provides protection for all organisms from harmful ultraviolet radiation. Unfortunately, there is no natural or practical mechanism for moving harmful ozone from ground-level to the upper atmosphere where it acts as a protective shield.

Chemicals produced by humans are eroding that upper atmospheric (or stratospheric) ozone layer, exposing the earth's surface to increases in ultraviolet radiation. Chemicals such as chlorofluorocarbons (CFCs) and halons, composed of chlorine and bromine, are transported up to the stratosphere. They are responsible for this ozone layer depletion. These chemical substances have an extremely long lifetime. The major CFCs include CFC-12 (used in mobile air conditioners), CFC-11 (used in industrial air conditioners), miscellaneous CFCs (propellants and cleaning agents), halons (fire extinguishers) and replacements for the CFCs known as HCFCs. The HCFCs and related compounds have a much shorter lifespan than the compounds they replace and as a result they pose a less, although still significant, threat to the ozone layer.

In 1987, Canada joined many other countries in signing the Montreal Protocol — an agreement that sets out a short- and long-term schedule to control all substances that deplete the ozone layer. In the short term, the agreement establishes phase-down requirements to reduce emissions of specified ozone-depleting substances. In the long term, it establishes a flexible mechanism by which control measures can be periodically assessed and adjusted to reflect the latest scientific findings. For example, in 1989 the participating countries decided to speed up this timetable to 85% reduction by 1997. Furthermore, CFCs, halons and carbon tetrachloride will be completely phased out by the year 2005.

The Montreal Protocol is a unique event, demonstrating a great willingness on the part of world leaders to act decisively and cooperatively when confronted with well-documented science outlining a serious environmental situation. The phasing out

of CFCs and halons will not eliminate the problem. These compounds have a very long lifetime and each molecule of stratospheric chlorine and bromine derived from these compounds is capable of destroying several thousand ozone molecules before being destroyed.

No CFCs are manufactured in British Columbia. As a result, an inventory of these compounds was reasonably straight forward. The weighted data from the 1990 inventory are given in Figure 7 below.

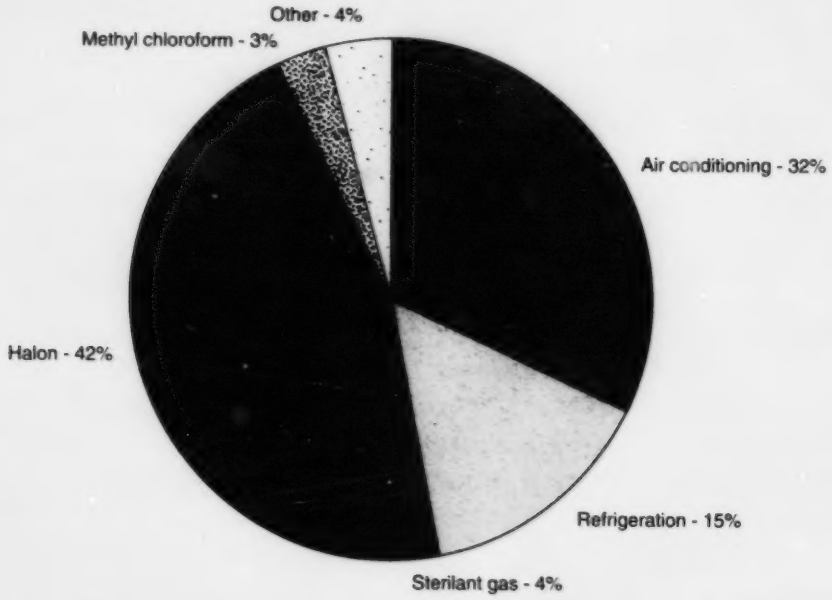

Figure 7. Ozone-depleting emissions in British Columbia weighted to CFC-12 in 1990.

Global Climate Change The theory of the "Greenhouse Effect" is well known by scientists; in fact, it is the natural greenhouse that creates the conditions that support life on earth. Without the greenhouse effect our planet would be approximately 33°C colder than we know it. The fact that the global population is discharging compounds into the atmosphere that may cause the atmosphere to warm further is also well known. This process, known as the "enhanced greenhouse effect," is due entirely to the activities of society. Presently, there is insufficient evidence to state that these emissions are causing the global atmosphere to warm. However, a recent report prepared by the Intergovernmental Panel on Climate Change (IPCC)

summarized the scientific consensus suggesting that warming on the order of 2 to 5°C may occur in the next 50 to 100 years.

The ramifications of such changes are immense since a warming of this magnitude in such a short period is greater than anything experienced in the last 160,000 years. Present climate models predict large shifts in temperature and precipitation patterns and increases in sea level. The potential exists for rapid changes in energy use and agricultural boundaries, and the possible elimination of unmanaged ecosystems. The stresses on the social and economic infrastructure of the world could be disastrous.

The IPCC report states that, *"These processes are partially understood, and we are confident that the uncertainties can be reduced by further research. However, the complexity of the system means that we cannot rule out surprises."* Consequently, a national action strategy has been prepared by federal and provincial ministries of energy and environment to help meet Canada's international commitment to stabilize greenhouse gas emissions. There are four key components to this strategy:

- Limiting greenhouse gas emissions.
- Anticipating and preparing for potential climatic changes that Canada may experience as a result of global climate change.
- Improving scientific understanding and increasing predictive capability with respect to climate change.
- Developing sinks to absorb greenhouse gases.

Greenhouse gas emission inventories for British Columbia were completed during 1990 and 1991, and possible options for their control were developed. The major greenhouse gases considered were carbon dioxide (CO_2), methane (CH_4), CFCs, nitrous oxide (N_2O) and oxidants ($NO_x/VOC/O_3$) (see Figure 8). Reports on these inventories are available on request.

What happens to the gases that are suspected of causing global climate change after they enter the atmosphere is an uncertain and complex process. Their contribution depends both on the physical characteristics of the gases and their atmospheric lifetime. For example, the average carbon atom making up a CO_2 molecule spends its life being shunted from one place to another: from fossil fuel to the air, from the

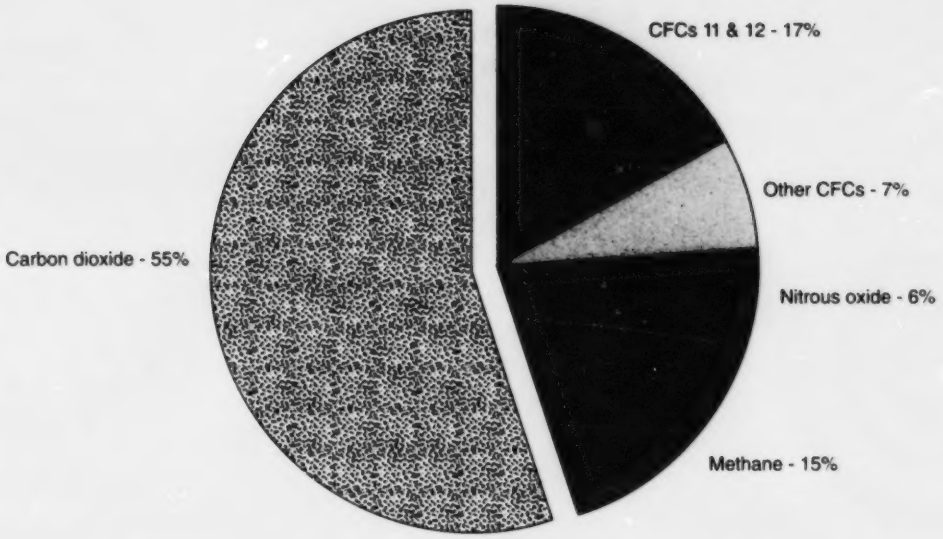

Figure 8. Relative contribution of greenhouse gases by type of gas (Source: IPCC 1991).

air to the oceans, from the oceans to fish and other marine organisms, from them to the sea bed, from there to the surface again, then to the atmosphere where it can be used by plants, enters the soil and eventually end up again in a fossil fuel. This is known as the global carbon cycle (see Figure 9) and its exact workings are not completely understood. Most carbon cycle models assume that approximately one half of the CO_2 released by burning fossil fuels in the atmosphere stays there, the other half being absorbed by the oceans and plant life. There are an estimated 725 gigatonnes (10^9 tonnes) of carbon present in the atmosphere, 37,000 gigatonnes in the oceans, 5,000 to 10,000 gigatonnes stored as fossil fuels, 1,300 to 1,400 gigatonnes in the soil and surface litter, and 560 gigatonnes in the biomass. These values, however, are not static and there is a continuous interchange between the various carbon storage zones. Approximately 3 gigatonnes are unaccounted for in the carbon cycle. The existence of this imbalance demonstrates our lack of understanding of this complex issue.

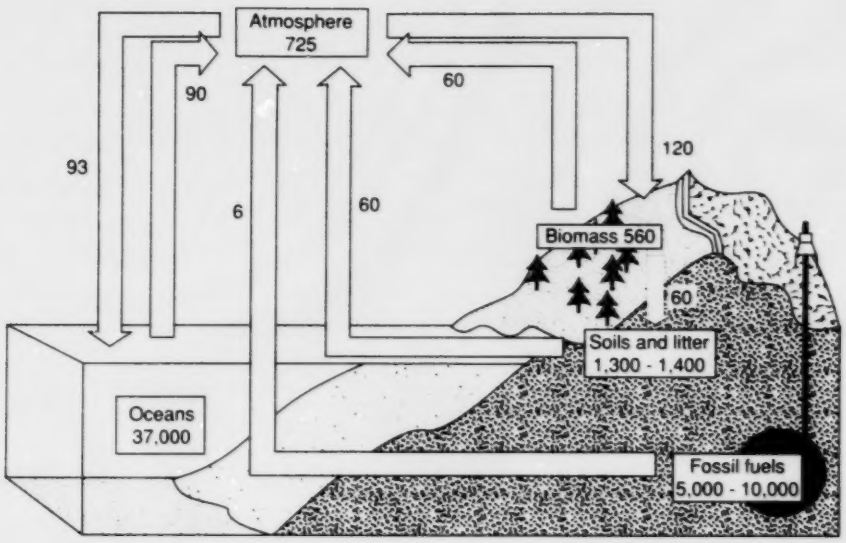

Figure 9. A simplified schematic of the global carbon cycle. Values in boxes show stored carbon in gigatonnes (10^9); values on arrows show flux of carbon in gigatonnes of carbon/year (Source: UNEP, 1987).

Further examination of Figure 9 demonstrates the serious ramifications of society's activities. If we increase fossil fuel consumption and/or remove biomass, the atmospheric carbon will rise rapidly. It is believed that the remainder of the sinks for carbon will be unable to absorb this increase.

Carbon Dioxide CO_2 is a natural component of the Earth's atmosphere. However, since the beginning of the industrial revolution, CO_2 levels have been steadily increasing. In British Columbia the major human-made sources of this gas are the pulp and paper industry, prescribed burning, transportation, and solid waste disposal (hog fuel and sawmill residues) (see Figure 10).

Methane CH_4 concentration in the atmosphere has doubled in the last 100 years and, on a molecule for molecule basis, its effect as a greenhouse gas after 20 years is about 63 times greater than CO_2 and after 100 years the effect is approximately 21 times that of CO_2. The atmospheric lifetime of methane is less than 10% of that of CO_2 and is estimated at about 10 years. This gas is produced naturally through the decay of vegetation, and through the activities of society such as coal mining, burning of fossil fuels, i.e., certain agriculture practices, and landfilling. Methane is normally oxidized in the atmosphere, but this process may be impeded by the presence of carbon monoxide from fossil fuel combustion.

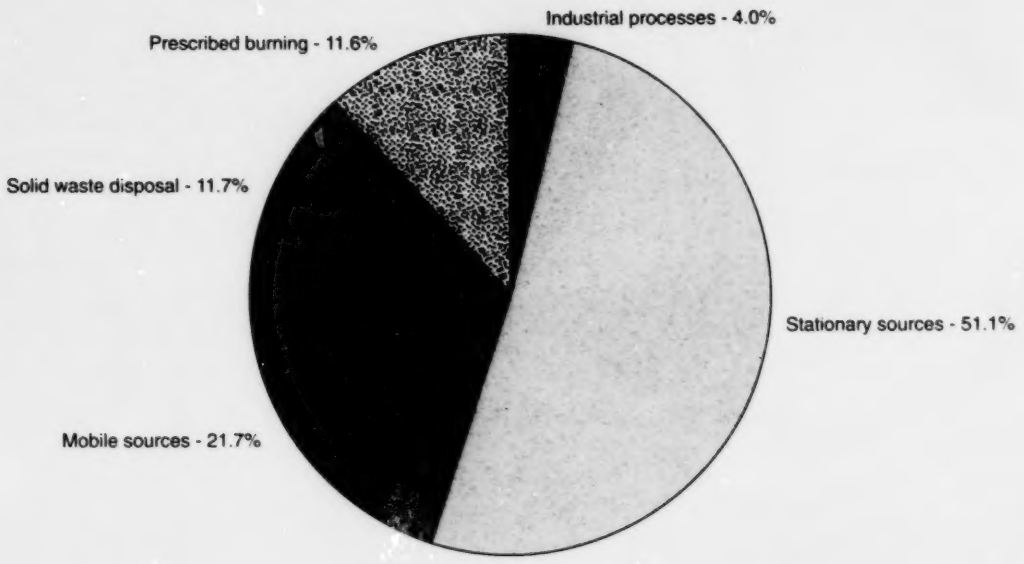

Figure 10. CO_2 emissions (%) in British Columbia from human source in 1988.

Globally, approximately 570 to 578 megatonnes of methane are emitted into the atmosphere annually and 525 to 535 megatonnes are removed by the atmosphere and the soils. The net atmospheric increase is estimated at 44 megatonnes per year.

In British Columbia, approximately 0.7 megatonnes of methane were emitted in 1990 and more than 77% of these emissions came from human sources. The major human sources of methane in our province are shown in Figure 11.

Chlorofluorocarbons CFCs, unlike other greenhouse gases, are not produced naturally. These constructed molecules are approximately 1,000 to 7,000 times more active as greenhouse gas than CO_2. New substitutes to replace CFCs are coming on the market and it is hoped that new emissions of CFCs will be all but eliminated in the next few years. However, the extremely long lifetime of CFCs (60 to 400 years) means that they will remain in the atmosphere contributing to the global climate change problem well into the next century. Recent inventory data indicate that CFC-12 emissions are the major CFC contributor to global climate change from British Columbia (Figure 12).

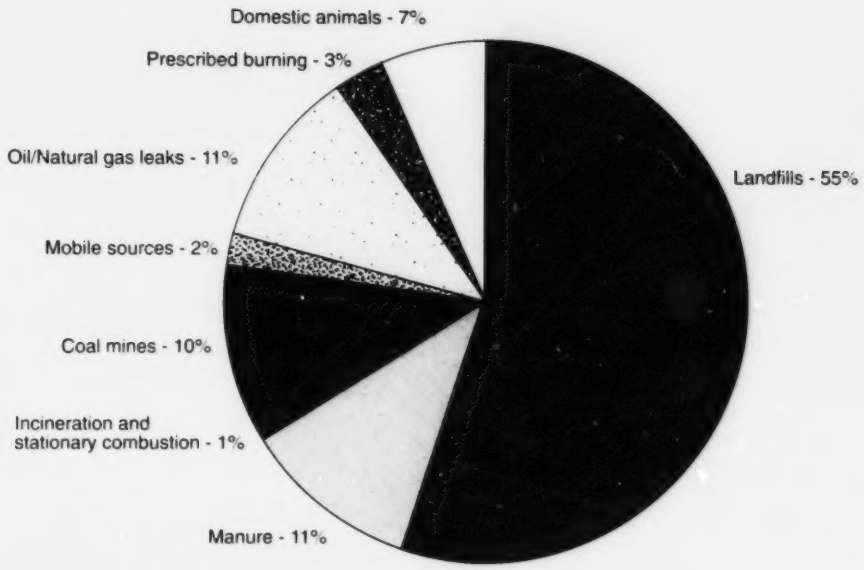

Figure 11. Methane emissions (%) in British Columbia from human sources in 1990.

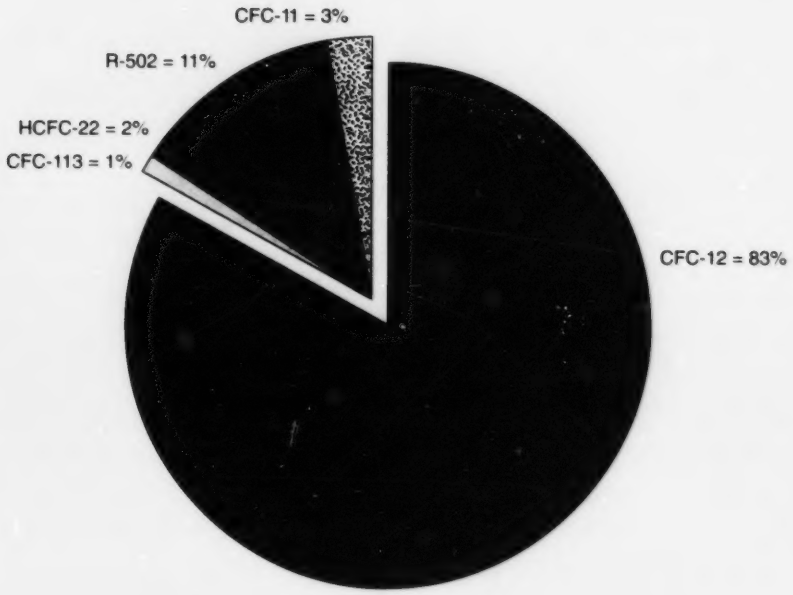

Figure 12. Distribution (%) of major CFCs in British Columbia.

It is of interest to note that this CFC, one of the most powerful greenhouse gases, is used in automobile air conditioners, from which it frequently escapes. This accounts for more than 50% of the CFC-12 emitted in this province (Figure 13).

Nitrogen Oxides, Volatile Organic Compounds and Ozone Recent published data prepared by the IPCC indicate that over 100 years, NO_x will contribute 6% and N_2O 4% to total potential global climate change. VOC, non-methane hydrocarbons, will contribute 0.5% to the total effect. The impacts of NO_x and VOCs are calculated on the basis of their contribution to the formation of ground level O_3, which is a greenhouse gas in its own right.

N_2O, a greenhouse gas, has a lifetime of 150 years and a global climate change potential, after 100 years, of 120 times that of CO_2. Human sources of N_2O include fossil fuel combustion, biomass burning, fertilizers, and cultivated natural sources.

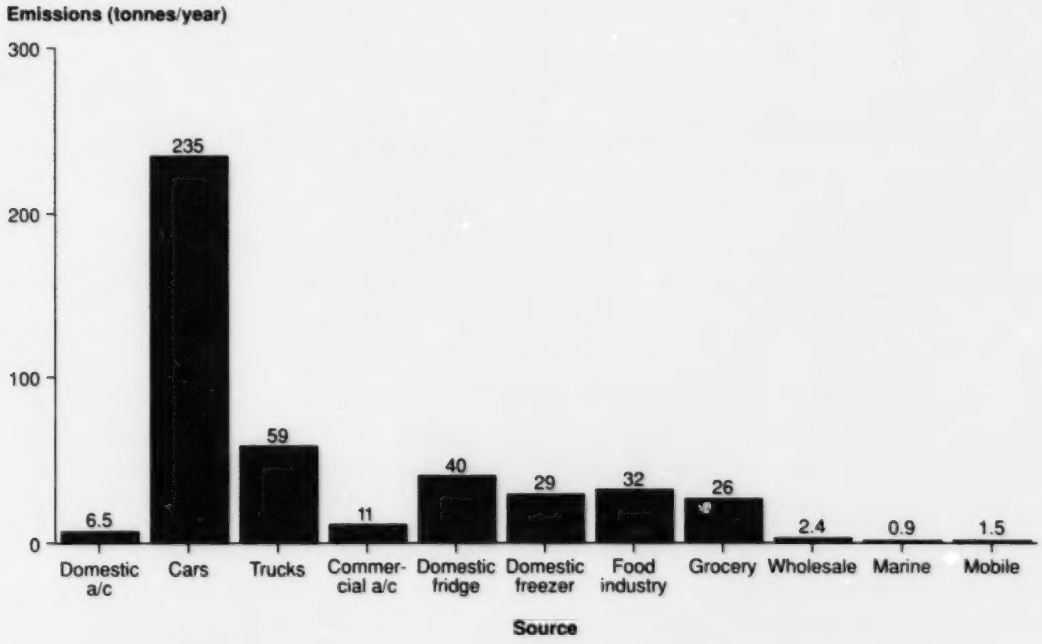

Figure 13. CFC-12 emissions in British Columbia in 1990.

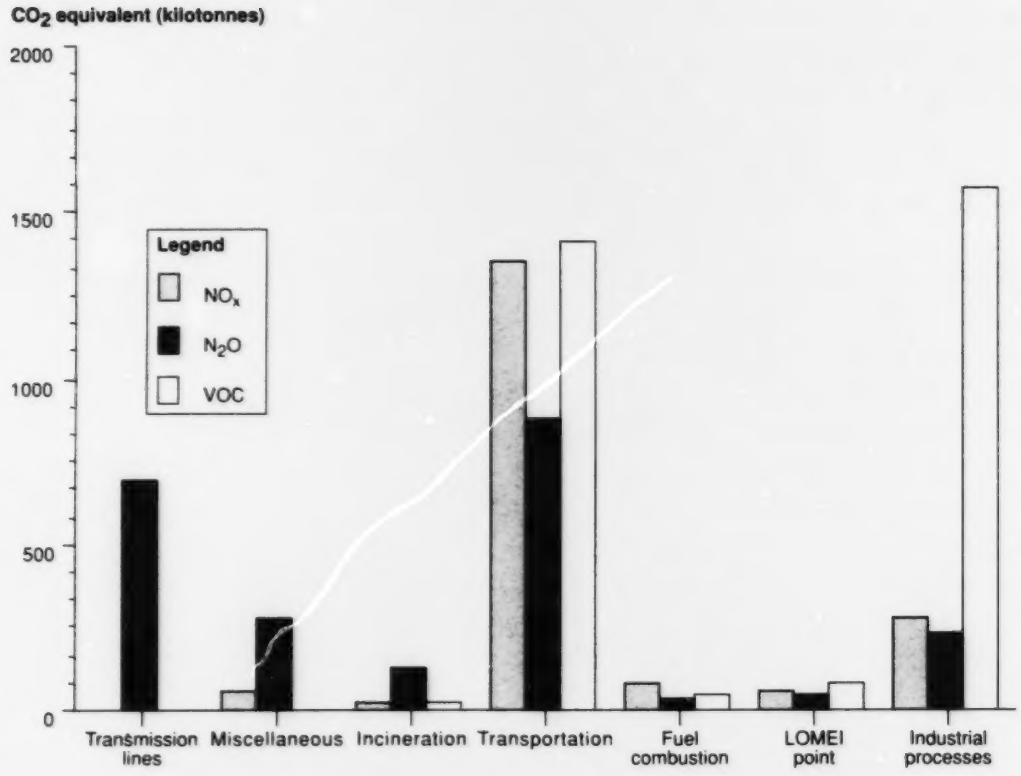

Figure 14. Sources of human-made NO_x, N_2O and VOC in British Columbia, plotted as CO_2 equivalents.

Figure 14 shows the major human sources of NO_x, N_2O and VOC. However, it should be noted that the dominant source for all of these emissions in British Columbia is not human — rather, biogenic sources account for approximately 61% of NO_x (e.g., soils, forest fires, lightning, and marine waters), 84% of N_2O, and 90% of VOC (e.g., vegetation and forest fires) emissions.

As one may have noted in this section, the causes of the global issues, regional issues and local issues are frequently related. This demonstrates the complexity of the atmosphere, how all scales of effects and pollutants are inter-related. It also demonstrates that solutions at the local scale, if carefully thought out, can have positive effects at the other two scales, giving meaning to the phrase *think globally, act locally*. Holistic thinking is essential in trying to solve these atmospheric issues.

3
SUMMARY OF STAKEHOLDER VIEWS

The Clean Air Strategy process was initiated on April 30, 1991 with the conference on *"Developing a B.C. Clean Air Strategy."* The conference was sponsored jointly by BC Environment, Environment Canada, the Greater Vancouver Regional District, and the B.C. and Yukon Chapter of the Air and Waste Management Association.

This conference was attended by 150 stakeholder participants representing industrial, environmental, academic, government, business, and community groups. The complete proceedings of the conference are documented in the conference report "Developing a B.C. Clean Air Strategy," and are available on request from BC Environment.

The objectives of the conference were twofold:

- To discuss a variety of existing and proposed air quality management initiatives and their coordination within the province.

- To provide a discussion and summary of the issues, options and points of view that should be considered in the public consultation leading to the development of a B.C. Clean Air Strategy.

Key issues from the conference have been copied directly from the conference report and are included in the following pages.

Clean Air Strategy

Participants felt it urgent that there be a clearly defined process for arriving at a Clean Air Strategy, including proposed goals, products and timetables with provision for stakeholder involvement and public education. They were often frustrated with the lack of government response and wanted assurance that there exists the political will to act on Strategy recommendations.

Jurisdictions and Decision-Making

Participants were concerned about the lack of clarity regarding jurisdictions and roles of government agencies in addressing air issues. They urged all relevant agencies to define their roles and to cooperate to resolve issues on a regional airshed management basis.

There was strong support among most participants for a regional airshed management authority for the Fraser Valley, with representation from key stakeholders. Besides responsibility for air quality objectives, standards and regulations, this body should be able to influence regional development and transportation. Similar groups could be developed for other priority airsheds.

There was also strong support for using regional planning to address air issues in the GVRD. The goal is to better integrate decision-making on regional population growth, land use planning, energy and transportation. Restoration of planning powers to the GVRD was proposed.

More research is needed to provide the scientific basis for decision-making. Interdisciplinary research is the key to dealing with complex air problems which must also be addressed in an integrated way so that new problems are not created. Technological innovation is essential to provide other tools besides regulation.

Standards and Regulations

Participants largely agreed that B.C. currently lacks a systematic and effective air management strategy. The Clean Air Strategy should outline a clear process for defining and implementing air quality regulations, policies, objectives, standards and permits, in full consultation with stakeholders. Pollution control objectives and criteria should be updated and more work is needed on ambient standards and their relation to Best Available Control Technology (BACT). The goal should be prevention of discharges, working towards "zero" emissions.

Several participants noted that there has been too much emphasis on pollution control and not enough on pollution prevention. Technological development and government regulations should focus increasingly on prevention measures, using a diverse array of approaches, including both "carrots" (i.e., incentives) and "sticks" (i.e., laws/regulations).

Participants also feel that there should be greater enforcement of existing legislation and a willingness to act on problems. BC Environment needs more resources to develop and enforce regulations. Additional regulatory concerns include pollutant mixes (synergistic effects), toxic air contaminants and unregulated air emissions.

Economic Issues and Instruments

Participants identified the need for environment-economy integration in decision-making affecting air quality. The costs of air quality impacts should be considered when assessing new projects (i.e., internalize environmental costs).

Economic instruments were recognized as key tools in achieving air quality goals, yet technical problems remain (e.g., non-quantifiable benefits and costs). More work is needed to develop useful types of economic analysis which address analytical limitations and incorporate stakeholder views. Workshop participants proposed the formation of a working group to research economic instruments, including: their use elsewhere, their effects and issues of equity and fairness.

Energy

It was suggested that B.C. needs a systematic approach to energy planning which incorporates environmental factors, including air quality. The Province should examine long-term energy needs, sources and alternatives. It should develop incentives and regulations for energy efficiency, conservation, alternative energy and non-polluting technologies. Energy planning should also be integrated with an economic strategy.

There was general agreement that B.C. should reduce greenhouse gas emissions, using measures such as public education, energy efficiency, energy conservation, fuel substitution, improved technologies and enhancement of greenhouse gas sinks (e.g., forests). Some participants felt that we need to define B.C.'s (and Canada's) share of the responsibility to limit greenhouse gas production. This would involve negotiations with the federal government and development of a B.C. position on national emission caps for presentation at CCME.

One energy workshop also expressed concern regarding emissions from the energy production and transmission sector, especially SO_2, NO_x, but also H_2S, particulates, VOC and ozone. More effective emission and impact monitoring programs were recommended. Co-generation schemes should be fully assessed to identify net environmental benefits.

Transportation

Participants generally agreed on the need to reduce urban sprawl and vehicle dependence through changes in both technology and lifestyle. Efforts should be aimed at reducing emissions per kilometre driven, and reducing total journeys. Vehicle emissions must be reduced through more stringent legislation and regulations combined with incentives to promote low-polluting, fuel-efficient vehicles.

Better regional transportation planning should create a properly integrated, minimally polluting and convenient transportation network. Participants proposed diverse measures to reduce vehicle use, drawing on "Clouds of Change" and ideas from California. These include: incentives for carpooling and vanpooling, high occupancy vehicle (HOV) lanes, expanded park'n ride, and employer transportation plans. We should be shifting our work habits through greater use of innovations such as teleconferencing, telecommuting and nodal offices. Municipal and regional planning should promote new urban forms through measures such as higher densities, decentralized jobs and regional town centres.

It was also noted that the auto lifestyle is highly subsidized. Government agencies were encouraged to adopt full cost accounting for vehicle infrastructure when deciding about transportation options. This may mean greater subsidies to urban transit so that transit infrastructure and services can be expanded. Urban transit agencies should expand their role to include transportation management (e.g., car and vanpooling, bicycle infrastructure and commuter rail). There was widespread support for encouraging greater bicycle use. Despite Vancouver's bicycle advisory committee and bicycle plan, participants felt that more initiatives are needed.

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Forest Products

One forestry workshop suggested that we need a better understanding of the linkages between forestry practices and global warming, especially the role of forests in the carbon cycle. They recommended more research on this issue and expanded education of the forestry community and the public.

Another general concern from a forestry workshop was how to determine acceptable emission levels from forestry activities. Further applied R & D on air pollution problems, opportunities and alternatives in the B.C. forest industry is proposed.

A specific concern in the forestry sector is burning of slash, teepee and land sort debris and its impacts on the nutrient value of wood, utilization of marginal fibre and soil. Alternative practices and technologies must be explored to maximize energy efficiency and minimize environmental impacts. Other forestry issues include particulate emissions, small scale wood burning for heat and power, and weaknesses in sampling and statistical methods for forestry emissions.

The participants of this Conference agreed that a Clean Air Strategy is urgently needed and welcomed the opportunity to contribute. One of the strongest messages put forward by participants was their desire for continued involvement in the development of the Strategy and in on-going air quality initiatives.

4
Proposed Process

A Clean Air Strategy for British Columbia will be developed through a consultative process with stakeholders during 1992. The details of the process will be confirmed by the Steering and Advisory Committees during the early stages of the process. Seven factors relating to the organization and process will be confirmed.

Organization

An inter-agency Steering Committee at the Assistant Deputy Minister level will provide overall direction to the project. The strategy development process will be supported by a BC Environment staff team and a Technical Working Group, with input from consultants. A multi-stakeholder Advisory Committee will be formed to provide ongoing feedback on the process to the Steering Committee.

Communication

A communication plan will be developed to ensure that stakeholders are kept informed of progress.

Information Gathering

The Technical Working Group and the BC Environment staff team will gather information during the winter and spring of 1992, working with consultants where necessary on technical data gathering, analyses of related initiatives, and evaluation of new approaches.

Targeted Consultation

During the spring and summer of 1992, stakeholder groups will be consulted on a number of elements of the strategy, including smoke management, greenhouse gas management, and regional air quality planning.

Draft Strategy

A draft strategy will be prepared during the late summer of 1992, based on the earlier information gathering and consultation.

Public Consultation

The draft strategy will be made widely available for comment over several months in the late fall and early winter of 1992. Public consultation will be linked to Ministry and other processes where possible.

Provincial Workshop

Prior to finalizing, the revised strategy will be presented to stakeholders for discussion at a provincial workshop in the winter of 1992/93. This is seen as an extremely important step, since the implementation of a comprehensive strategy will rely on extensive cooperation.

5
ANTICIPATED OUTCOME

The final development of a Clean Air Strategy for British Columbia will be the result of extensive stakeholder feedback and discussions. It is anticipated that the process will lead to several ends:

- An overall vision for atmospheric quality in British Columbia.
- Definitions of the issues important to British Columbians
- Clear priorities for pollution prevention and management activities.
- A description of consultative processes needed in the future.
- Agreement on cooperative approaches and decision-making frameworks.
- A mix of short-term actions, and longer-term approaches:
  - — Legislation, regulation and enforcement.
  - — Policy and standards.
  - — Market-based measures.
  - — Ambient environmental monitoring.
  - — Research, monitoring, inventory and assessment.
  - — Strategic and operational plans.
  - — Regional planning initiatives and coordinating mechanisms.
  - — Public education and involvement.
  - — Regular reporting.
  - — Environmental assessment

Many of the elements of such a strategy were outlined by the participants at the conference *"Developing a B.C. Clean Air Strategy."* Some initiatives are already underway and will assist in the development of a final plan; these are described on the following pages. These initiatives supplement ongoing management efforts through the permitting, monitoring and enforcement of waste discharges.

Elements of a Clean Air Strategy

Smoke Management Policy

One of the most common air quality concerns reported within our province was the issue of smoke from various types of wood-burning. A Smoke Management Discussion Paper is being released, concurrent with this document, for stakeholder review. This paper deals with sources of woodsmoke such as burning prescribed by the B.C. Ministry of Forests and the burning of wood residues in teepee burners, the operation of woodstoves and the burning of biomass in backyard incinerators or open piles.

The purpose of this paper is, by promoting discussion on this controversial topic, to develop policies based on stakeholder input that reduce the impact of woodsmoke emissions. For example, recent policy changes on the pricing of electricity generated from woodwaste will make it more practical for industry to consider the option of generating electricity from wood residues; a policy actively promoted by BC Environment.

In addition, other options being considered to reduce the impact of smoke within our province are listed here:

- Consider alternatives to slash burning where conditions permit and promote emission reduction through rapid mop-up of smouldering fires.
- Improve use of meteorological information to limit the impact of smoke from prescribed burning.
- Develop a "zero waste" policy to encourage the use of low-grade wood left on logging sites.
- Eliminate all teepee burners in urban and smoke sensitive areas.
- Encourage municipalities to eliminate all yard residue burning.
- Encourage the use of certified woodstoves and develop a program to determine "no-burn" days based on meteorological forecasts.
- Improve monitoring of small particulates and other constituents of smoke.

Greenhouse Gases Management Strategy

An inventory of major greenhouse gases emitted in British Columbia will be completed and released in early 1992. The gases examined included CO_2, CH_4, CFCs and halons, and NO_x, N_2O, VOCs and O_3.

An overall management plan must now be developed, based on established emission reduction targets, and on an evaluation of the costs and benefits of the management options available. Consideration will be given to the combined aspects of the management plan to ensure that the reduction of emissions from one greenhouse gas does not adversely increase emissions of another greenhouse gas. In addition, the impact of other initiatives, such as the NO_x/VOC management plan, the smoke management policy and the ozone-layer depletion strategy must be carefully assessed so as to ensure that they do not affect the overall reduction of greenhouse gases in our province.

A provincial management strategy for greenhouse gases will also require careful integration with other efforts, including the National Action Strategy on Global Warming and the national Green Plan. Stakeholder consultation will be an essential part of the process. Much of this will occur during the development of the comprehensive Clean Air Strategy.

Ozone Smog Management Strategy

A British Columbia strategy is needed to manage the NO_x and VOC emissions responsible for ground-level ozone smog. Such a strategy will be developed, based in part on an assessment of the most effective means of implementing some 50 emission reduction measures and 30 study initiatives proposed in the CCME NO_x/VOC Management Plan for Canada. A report describing the CCME Plan is available on request from BC Environment. It should be noted, however, that this Plan does not identify all the actions that are probably necessary.

While a primary objective of the CCME NO_x/VOC Management Plan is to resolve the ground-level ozone problems in large urban areas like the Lower Fraser Valley, it should be noted that its measures will also assist in addressing the greenhouse gases issue. The CCME Plan recognizes that emission source controls, energy conservation and lifestyle changes will all be necessary to resolve urban ozone smog problems. The cost to implement the plan nationally is estimated at $100 million to government over the next five years, with associated costs to emitters estimated at $855 million annually by the year 2005.

In British Columbia, some activities are already underway that will contribute to the goals outlined in the CCME Management Plan. In the Lower Fraser Valley, the AirCare program, which will require annual vehicle emission inspections and maintenance, will be fully implemented by July 1992. In addition, a number of measures are underway to reduce gasoline vapour losses, a major source of VOCs, particularly during the summer season.

A British Columbia ozone smog management strategy may include the following:

- Emission reduction and other actions to be taken in the short term.
- Monitoring and inventory programs in areas of rapid urban growth.
- Airshed modelling to assess effective long-term strategies.
- Effective linking of air quality, transportation and land-use planning.

Ozone-layer Protection Strategy

British Columbia is one of the first provinces to take an active role in developing regulations for ozone layer depleting substances. Draft regulations have now been prepared and have been out for review by industries, services, and government agencies that may be affected, and by interested public groups. It is anticipated that the draft regulations will be revised based on this review, and a plan for implementation prepared during 1992. Market-based approaches are also being investigated.

The draft regulations focus on the major ozone layer depleting substances: CFCs, halons, methyl chloroform and carbon tetrachloride. The intent of the regulations is to prevent the release of most of these substances into the atmosphere. The emphasis of the regulations is to ensure that these substances are recovered in a way that reduces emissions to the lowest achievable level and that the materials are reused, recycled, reprocessed or held for destruction.

The regulations address requirements for businesses that service or repair, or companies that manufacture, sell or supply refrigeration or air conditioning equipment, packaging materials or containers, or rigid or flexible foams where ozone layer depleting substances are used as a foaming agent. There are also restrictions for companies that use solvents (e.g., dry cleaners, electronics), that

discard any device that contains ozone layer depleting substances, or that use CFCs for sterilization.

Regional Air Quality Management Plans

Regional efforts will be required to effectively manage the air quality issues associated with the growth of population centres. Currently, regional air management planning is focused on the Lower Fraser Valley, due to the air quality situation in that area.

The Greater Vancouver Regional District is the only region in the province that has been delegated responsibility for air quality management under the Waste Management Act. For this reason, the GVRD and BC Environment coordinate their air quality management efforts closely in that area. The GVRD has responsibility for issuing permits for industry in its area, and operates an extensive air quality monitoring network. The GVRD Board has adopted the challenging goal of reducing regional emissions of major pollutants by 50% of their 1990 levels over the next decade. In recent years, extensive resources have been devoted to assessing the potential consequences of continuing growth, and the possibilities for managing emissions to insure good air quality.

The Ministry and the four regional districts in the Lower Fraser Valley (GVRD, Dewdney-Alouette, Central Fraser Valley and Fraser-Cheam) are considering methods of better coordinating air quality planning efforts, including the possibility of forming a regional air management authority. Such an authority has been proposed by a number of groups, including the City of Vancouver and the Vancouver Board of Trade, as well as the four regional districts mentioned above.

In recent months, the regional districts responsible for the Greater Victoria area (Capital Regional District) and the Okanagan Valley (North and Central Okanagan, and Okanagan-Similkameen) have started discussions on air quality issues in their regions. These discussions could lead to the development of regional air management plans.

In other parts of the province, a number of initiatives related to air quality have been undertaken in individual communities. Examples include public air quality index reporting in Prince George, and woodstove control during inversion periods in Cranbrook and Comox.

In the future, air quality management plans and regional coordinating mechanisms are likely to play an increasing role in helping to achieve community environmental goals, as well as contributing to the resolution of national and international issues.

Longer Term Planning Efforts

In the longer term, we can influence the shape of our communities and our collective impact on the environment — locally, regionally and globally. Because of their extensive and long-lasting impact, three areas are particularly important:

- Energy source and demand.
- Transportation mode and demand.
- Community design and land use.

These areas are closely linked to each other, and to the need for broad solutions involving changes in lifestyle.

Energy

In British Columbia, much of our household energy comes from hydro-electric power. This form of power is renewable and is benign in terms of atmospheric effects *(although it has other environmental costs including some CH_4 release from flooded lands)*. In the future, consideration may be given to meeting our additional energy needs from a variety of sources, including thermal generation from the combustion of coal, gas or wood residues and other renewable sources such as wind, solar and geothermal power. These choices will require careful evaluation to ensure that the best long-term decisions are made.

Transportation

Transportation is the source of many of the emissions linked to the atmospheric issues described earlier. In urban areas such as greater Vancouver, there is an increasing focus on reducing vehicle use and, consequently, reducing urban sprawl, energy use, air emissions and commuting time. Vehicle emissions can be reduced through a combination of improved alternatives (e.g., transit and cycling), better management of our present use (e.g., combining trips and carpooling), significantly

more efficient and less polluting vehicles and, in the longer term, a reduction in our travel requirements (e.g., telecommuting, better balancing of the location of jobs, and better land-use planning).

Many of the actions possible in transportation and energy demand management are economic in their own right and are easily encouraged. Others, however, involve several levels of government and cooperation across many jurisdictions to work. Even more difficult are changes in lifestyle and human behaviour. These require education and understanding before they can be widely accepted.

Tools for Implementing a Strategy

Air Quality Standards and Objectives

For protection of our atmospheric environment, both emission standards (e.g., for smoke stacks and tailpipes) and objectives for community (ambient) air quality are necessary.

In British Columbia, many stack emission standards were created in the 1970s and require updating to reflect modern pollution control technology. This updating will occur in consultation with stakeholders. It will need to continue on a regular basis.

New standards are also needed for the modern era of chemicals commonly known as "air toxics". Included in this category are chemicals such as dioxins and polycyclic aromatic hydrocarbons (PAHs). In some cases, further research is needed to support sound environmental standards. BC Environment works closely with the CCME in this area to take advantage of the best information available and to ensure that standards developed for B.C. are consistent with those developed elsewhere.

Monitoring and Inventory

Ambient air quality monitoring provides an assessment of the quality of the air experienced by British Columbians. It helps to identify the need for management measures to prevent environmental or human health being compromised. By calculating the changes in air quality with time, one is able to assess the effectiveness of our management strategies in reducing air pollution and in addressing air pollution issues.

Monitoring information can be used to support public air quality indices (such as the GVRD Air Quality Index, and Prince George TRS Index), or to trigger action to reduce emissions during an episode of poor air quality (such as woodstove curtailment programs in Cranbrook and Comox, and public air quality advisories in the Lower Fraser Valley). When combined with meteorological information, monitoring data can be used to forecast air quality — this technique is currently being developed for the Lower Fraser Valley.

Efforts are underway to improve the air quality monitoring network in British Columbia. Information on stack emissions from industrial sources also needs to be monitored. When such information is combined with meteorological information in computerized dispersion models, the atmospheric impact of existing or proposed emissions can be determined. This is a critical piece of information in decision-making.

Inventories of pollutant emissions can also be developed, based either on direct stack emission measurements, or on indirect estimates of pollutant emission (using fuel consumption or other surrogates where direct measurements are not available). The most recent inventory for British Columbia was based on 1985 information. It is now being updated for 1990. This information, when combined with the recently completed greenhouse gases inventories, will provide a good picture of the sources responsible for emission of the most significant pollutant gases in British Columbia.

Market-based Measures

There is an increasing focus in many jurisdictions on the use of market-based incentives as an alternative to traditional regulatory approaches to pollutant management. Such incentives place a value on environmental commodities that have often been regarded as free, such as air and water. Placing a value on such commodities through the use of market-based measures can provide a powerful and effective signal in influencing behaviour.

Market-based measures include a range of taxes and fees, incentives, subsidies, and tradeable emission permits. In general, the primary purpose of market-based incentives is to influence behaviour rather than to raise revenue; a successful program will actually face declining revenue! Funds raised by taxes and fees can be used to offset the cost of managing the emissions. Current examples include levies on tires and batteries, which are placed in the Sustainable Environment Fund.

BC Environment is assessing a variety of market-based measures for pollution prevention. An assessment of emission trading has recently been completed by a working group reporting to the CCME. This work included an evaluation of the Lower Fraser Valley that suggested that emission trading could provide an effective means of improving air quality while allowing for the continued growth anticipated in the region. This concept will be evaluated in more detail in coming months.

Information and Education

Air quality management will increasingly need to rely on new approaches. Chief among them is securing the cooperation and understanding of the general public. In addition, because of the inter-relationships between the issues, a wide variety of sectors and agencies will need to be onside. An increased emphasis on information and education will be required if such a large number of interests are to act cooperatively.

Research Needs

Much of the information needed to support sound environmental decisions relies on research done in cooperation with other jurisdictions. Inevitably, additional work is required to apply research results to the specific British Columbia geography. For example, there are a number of atmospheric issues for which such work is needed. These include the effects of pollutants on ecosystem health, particularly acid deposition in the high precipitation areas of southwestern British Columbia. There are also a number of questions about the nature of ozone smog episodes in the Lower Mainland.

Your comments on this document are welcome.

REFERENCES

Greenhouse Gas Inventories:

Carbon Dioxide Inventory for British Columbia (1990) — Available at a cost of $15 from Crown Publications Inc., 546 Yates Street, Victoria, B.C., V8W 1K8, Phone (604) 386-0221.

An Inventory and Analysis of Control Measures for Methane for British Columbia (In press) — Available April 1992 from Crown Publications Inc., 546 Yates Street, Victoria, B.C., V8W 1K8, Phone (604) 386-0221.

British Columbia Emission Inventory of Nitrogen Oxides, Volatile Organic Compounds and Ozone (NO_x/VOC/O_3) as Greenhouse Gases (In press) — Available April 1992 from Crown Publications Inc., 546 Yates Street, Victoria, B.C., V8W 1K8, Phone (604) 386-0221.

Ozone Depleting Greenhouse Gases in British Columbia (In press) — Available April 1992 from Crown Publications Inc., 546 Yates Street, Victoria, B.C., V8W 1K8, Phone (604) 386-0221.

Evaluation of CO_2 Management Measures (In press) — Available April 1992 from Crown Publications Inc., 546 Yates Street, Victoria, B.C., V8W 1K8, Phone (604) 386-0221.

Smoke Management for the '90s (In press) — Available March 1992. Air Resources Branch, BC Environment, 777 Broughton Street, Victoria, B.C., V8V 1X5.

Clean Air Strategy — Conference Report (April 30–May 1, 1991) (In press) — Available March 1992. Air Resources Branch, BC Environment, 777 Broughton Street, Victoria, B.C., V8V 1X5.

Air Quality Issues in British Columbia (1990) — Prepared for The British Columbia Round Table on the Environment and the Economy, Suite 229, 560 Johnson Street, Victoria, B.C., V8W 3C6.

Management Plan for Nitrogen Oxides (No_x) and Volatile Organic Compounds (VOC) — Phase I (1990) — prepared by the Canadian Council of Ministers of the Environment — Available from the Air Resources Branch, BC Environment, 777 Broughton Street, Victoria, B.C., V8V 1X5.

National Action Strategy on Global Warming (1990) — Prepared by the Canadian Council of Ministers of the Environment — Available from Canadian Council of Ministers of the Environment, 3rd Floor, Building 30, 139 Tuxedo Avenue, Winnipeg, Manitoba, R3N 0H6.

Air Quality in British Columbia 1983–1987 — Available from the Air Resources Branch, BC Environment, 777 Broughton Street, Victoria, B.C., V8V 1X5.

Acid Rain in British Columbia (1988) — Air Resources Branch, BC Environment, Victoria (out of print).

Sources for Additional Information

For British Columbia (and *Clean Air Strategy*):

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